

An evaluation of Voyage Date Recorders and S(Simplified)-VDR by maritime experts

Ocena VDR i S-VDR (rejestratorów danych z podróży) w opinii ekspertów morskich

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Abstract

This study presents the results of research aimed at assessing the importance of a Voyage Data Recorder (black box) in an analysis of the ship conduct. The analysis was performed by teams of Polish maritime experts, judges, a ministry delegate and jurors of the Maritime Court in Szczecin, experienced captains, chief engineers and officers of the watch of the merchant fleet.

Słowa kluczowe: Konwencja SOLAS 1974, awarie i katastrofy morskie, dowód, bezpieczeństwo żegluga

Abstrakt

Opracowanie przedstawia wyniki badań oceny znaczenia rejestratorów danych z podróży (Voyage Data Recorder) („czarna skrzynka”) w analizie przebiegu prawidłowości prowadzenia statku przez zespoły polskich ekspertów morskich, sędziów, delegata i ławników Izby Morskiej w Szczecinie, doświadczonych kapitanów i starszych mechaników oraz oficerów wachtowych floty handlowej.

Introduction

The aim of research into the role and importance of a VDR and S-VDR was to assess whether a ship that was involved in an accident was correctly conducted or not. Such research was undertaken in 2008 [1] and concentrated exclusively on accidents and disasters of sea-going vessels.

The reason for undertaking this topic was an alarmingly high number of accidents at sea where the human is to blame in the first place. Knowing who potential doers are, the authors decided to get a better insight into the reasons and work out new forms of defining the actual course of events. In such investigation, the black box theoretically at least, plays an important role.

The formulated research problem included the question concerning the role and importance does a VDR have in the assessment of ship conduct, and reached for details that might have explained to

what extent black box data may provide material helpful in preventing accidents, in terms of training and by adjusting legal procedures concerning safe navigation [2].

Initial research goals were to analyze the assessments of accidents based of verdicts of the maritime courts and equivalent bodies abroad. For many reasons required data turned out to be unavailable. Firstly, in the history of Polish Maritime Courts there has been only one accident where the court proceedings involved information contained in VDR readouts. Secondly, access to foreign materials was impossible due to the attitude of ship owners whose objections were on the grounds that their secrets could not be revealed for economic reasons – competitiveness on the world shipping market. The only thing available, on the Internet, was a synthetic description of the events with no names of ships or ship owners given [3].

For this reason, other research methods were employed: opinions of maritime experts, experienced captains and officers, maritime court judges and available conclusions found in professional publications and on the Internet [4].

Legal regulations concerning the Voyage Data Recorder (VDR) are based on the SOLAS Convention, Chapter V, Regulation 20, Resolution A 694 (17), Resolution A 861 (20), Resolutions MSC 163 (78) IMO and standards of the International Electrotechnical Commission IEC 61162 [5] and IEC 61996 [6]. This article is not concerned with the whole contents of the mentioned documents that regulate the requirements for the equipment of various ship types and sizes, technical, design and installation standards, supervision and control. Failure to satisfy those requirements would make it impossible to use data recorded by a VDR.

The table 1 specifies data and other information recorded by the VDR and its simplified version – S-VDR.

Table 1. List of data recorded by the VDR and S-VDR [7]
Tabela 1. Wykaz zapisywanych informacji przez VDR i S-VDR [7]

VDR	S-VDR
– date and time (GPS)	– date and time (GPS)
– ship's position (GPS)	– ship's position (GPS)
– speed (log)	– speed (log)
– course (gyrocompass)	– course (gyrocompass)
– bridge voice and VHF communication recordings	– bridge voice and VHF communication recordings
– radar image	– radar image and/or AIS
– water depth (echosounder)	– any code (NMEA) to the IEC 61162 standard
– wind speed and direction	
– ship alarms	
– wheel commands and rudder position readout	
– course maintained	
– setting and readout of engine telegraph position	
– ship identification	
– state of hull openings, watertight and fire doors (if any)	
– accelerations and hull stresses (if any measuring instruments)	

Research procedure

The research process was based on questionnaires answered by judges of the Maritime Court in Szczecin, Shipping Minister's delegate, jurors sitting on these courts and experts – master mariners, chief mates, chief engineers and deck officers [8]. There were 57 respondents, 97% of them graduates

of maritime universities, the remaining 3% graduated from the State Maritime School.

39.5% respondents had sea service longer than 20 lat, 25% over 11 years while 48% up to 10 years of service in officers' positions. 75% of the respondents represented the management level, the others – operational level.

The questionnaire was anonymous, and the evaluative responses referred to the issues of the role of VDR in the merchant fleet. The participants selected at random came from the Szczecin Club of Master Mariners, the Szczecin Association of Ship's Chief Engineers and Officers and from a group applicants to training courses for Chief Mates and ECDIS operation.

The questionnaire form consisted of nine questions: 2 multiple choice questions and seven open questions. Apart from the questionnaire results, the following sources were considered: 13 accidents described on the Internet, three accidents reported in *Seaways* No 2, 2007 and the accident of the mf *Stena Baltica* in the port of Gdynia on 14 March, 2006. Including the questionnaires, the research data included 74 accidents. This study includes exclusively the assessment of Polish maritime experts.

Questionnaire results

The jurors, minister's delegate and ship's management and operational personnel

According to the questionnaire research procedure, respondents were divided into three groups [8]:

- A) minister's delegate and maritime court jurors,
- B) ship's management personnel,
- C) operational level officers.

The results presented in the tables include opinions of the above groups, and the corresponding figures on the number and percentage of the answers received.

Question 1 (Tab. 2):

Was the obligation to equip passenger and other ships with VDRs a good move by the IMO? If yes, why?

The respondents' answers: Yes in group A – 100%; in group B – 94%, in group C – 84.5%, total – 93%.

Question 2 (Tab. 3):

Do you think evidence in the form of VDR recordings is reliable?

The respondents' answers: Yes in group A – 90%, in group B – 97%, in group C – 92.5%, total – 94.5%.

Table 2. Justifications [authors' study]

Tabela 2. Prezentacja uzasadnień [opracowanie własne]

Opinions Group	Total		Excellent evidence		Improvement of navigational safety		Possibility to reproduce an accident		Yes, no or another justification		No, or no answer	
	number	%	number	%	number	%	number	%	number	%	number	%
A	10	100	5	50	2	20	–	–	3	30	–	–
B	32	100	7	22	4	12.5	9	28	10	31.5	2	6
C	13	100	3	23	1	7.5	2	15.5	5	38.5	2	15.5
Total	55	100	15	27	7	13	11	20	18	33	4	7

Table 3. Reliability of evidence [authors' study]

Tabela 3. Wiarygodność dowodów [opracowanie własne]

Opinions Group	Total		Atesty		No intervention of third parties		Yes, with no or another justification		No, or no answer	
	number	%	number	%	number	%	number	%	number	%
A	10	100	3	30	3	30	3	30	1	10
B	32	100	3	9.5	4	12.5	24	75	1	3
C	13	100	–	–	–	–	12	92.5	1	7.5
Total	55	100	6	11	7	12.5	39	71	3	5.5

Table 4. Requirements for the equipment and recordings [authors' study]

Tabela 4. Wymagania wobec urządzeń i nagrań [opracowanie własne]

Opinions Group	Total		Required standards		Performance		Good quality of recording		Protection against manipulating		Yes, no or other justification		No, or no answer	
	number	%	number	%	number	%	number	%	number	%	number	%	number	%
A	10	100	6	60	4	40	5	50	5	50	2	20	–	–
B	32	100	8	25	3	9.5	8	25	7	22	–	–	6	18.5
C	13	100	–	–	7	53.5	–	–	–	–	4	31	2	15.5
Total	55	100	14	25.5	14	25.5	13	23.5	12	22	6	11	8	14.5

Table 5. Justifications [authors' study]

Tabela 5. Prezentacja uzasadnień [opracowanie własne]

Opinions Group	Total		Additional source of information		Reconstruction of events		Wider access to data		Yes, no justification		No, or no answer	
	number	%	number	%	number	%	number	%	number	%	number	%
A	10	100	4	40	1	10	2	20	3	30	–	–
B	32	100	4	12.5	15	47	9	28	3	9.5	1	3
C	13	100	2	15.5	4	31	5	38.5	1	7.5	1	7.5
Total	55	100	10	18	20	36.5	16	29	7	13	2	3.5

Question 3 (Tab. 4):

In your opinion, what conditions do VDR devices and recordings have to meet to be used for accident analysis?

Each respondent could give an unlimited number of answers.

Question 4 (Tab. 5):

Are VDRs helpful in the reconstruction of post-accident events? Why?

The respondents' answers: Yes in group A – 100%, in group B – 97%, in group C – 92.5%, total – 96.5%.

Question 5 (Tab. 6):

Which evidence is more important in case of inconsistencies in the investigation: witness statements or VDR recordings?

- Witnesses
- VDR records
- Hard to say

Question 6 (Tab. 7):

Should VDR evidence always be taken into consideration or only if there are any doubts?

- Always
- Only in doubt

Table 6. Respondents' answers [authors' study]

Tabela 6. Odpowiedzi respondentów [opracowanie własne]

Opinions Group	Total		Witness statements		VDR recordings		Hard to say		No answer	
	number	%	number	%	number	%	number	%	number	%
A	10	100	1	10	5	50	3	30	1	10
B	32	100	3	9.5	19	59.5	9	28	1	3
C	13	100	1	7.5	9	69.5	3	23	–	–
Total	55	100	5	9	33	60	15	27	2	4

Table 7. Respondents' answer [authors' study]

Tabela 7. Odpowiedzi respondentów [opracowanie własne]

Opinions Group	Total		always		only if doubts exist		no answer	
	number	%	number	%	number	%	number	%
A	10	100	8	80	2	20	–	–
B	32	100	30	94	1	3	1	3
C	13	100	8	61.5	4	31	1	7.5
Total	55	100	46	83.5	7	12.5	2	4

Table 8. Justifications [authors' study]

Tabela 8. Prezentacja uzasadnień [opracowanie własne]

Opinions Group	Total		good illustration and analysis		Indication of errors made		Prevention of similar accidents		Yes, no justification		No, or no answer	
	number	%	number	%	number	%	number	%	number	%	number	%
A	10	100	5	50	–	–	1	10	4	40	–	–
B	32	100	8	25	13	40.5	5	15.5	3	9.5	3	9.5
C	13	100	5	38.5	2	15.5	1	7.5	2	15.5	3	23
Total	55	100	18	32.5	15	27	7	13	9	16.5	6	11

Table 9. Justifications [authors' study]

Tabela 9. Prezentacja uzasadnień [opracowanie własne]

Opinions Group	Total		Analysis		Taking preven- tive measures		Indication of errors made		Yes, with no or other justification		No, or no answer	
	number	%	number	%	number	%	number	%	number	%	number	%
A	10	100	4	40	2	20	–	–	3	30	1	10
B	32	100	10	31.5	7	22	2	6	9	28	4	12.5
C	13	100	4	31	3	23	1	7.5	1	7.5	4	31
Total	55	100	18	32.5	12	22	3	5.5	13	23.5	9	16.5

Table 10. Accompanying emotions [authors' study]

Tabela 10. Towarzyszące emocje [opracowanie własne]

Opinions Group	Total		Yes		No		I do not know		No answer	
	number	%	number	%	number	%	number	%	number	%
A	10	100	7	70	–	–	2	20	1	10
B	32	100	25	78	1	3	5	16	1	3
C	13	100	7	54	4	31	1	7.5	1	7.5
Total	55	100	39	71	5	9	8	14.5	3	5.5

Question 7 (Tab. 8):

Should VDR recordings be used for training purposes? Why?

The respondents' answers: Yes in group A – 100%, in group B – 90.5%, in group C – 77%, total – 89%.

Question 8 (Tab. 9):

Can VDR recordings be a basis for taking preventive measures? Why?

The respondents' answers: Yes in group A – 90%, in group B – 87.5%, in group C – 69%, total – 83.5%.

Question 9 (Tab. 10):

Do VDR recordings render human emotions expressed before, during and after the accident?

The respondents' answers: Yes in group A – 70%, in group B – 78%, in group C – 54%, total – 71%.

Analysis of the questionnaire

Opinions of the maritime court jurors and one minister's delegate to the court (A) as well as opinions expressed by management and operational level officers (B; C) were generally similar in reference to the obligatory installment of VDRs on board passenger and cargo vessels. It has been recognized that VDRs may provide excellent evidence as it helps to reconstruct the events. The positive opinion concerning the reliability of recordings relies on the condition that technical standards are met, guaranteeing good quality of the recordings and satisfactory protection against unauthorized access and manipulation by third parties. The conclusion that follows is that there is deeply rooted lack of trust and confidence, that people may have wrong intentions and try to alter actual VDR recordings.

As for the differences in opinions on the reliability of evidence from VDR – a great majority of representatives of ship's management and operational personnel found black box information as reliable, while only 50% of jurors shared this view. However, it was indicated that VDR evidence should always be taken into consideration in accident investigations. It seems that jurors are affected by deeper post-accident analysis of the maritime court judges formulated during a court trial where the verdict depends on evidence reliability.

The use of VDRs recordings for training purposes is jointly supported by all respondent groups. The support is justified with such arguments as good description and analysis of the events, identification of frequently made errors and, consequently, prevention of marine accidents.

Similar answers were given to inquiries about possible use of VDR recordings for preventive actions; these in some justifications referred to personnel behaviour as well as revision of or amendments to existing legal instruments – orders or directives – issued at various levels: shipowner, national administration.

More than 70% of respondents in groups A and B, less in group C (54%) stated that in voices recorded on the bridge one can hear emotions accompanying officers and ratings during an accident: nervousness and stress, both negatively affecting decisions to be taken.

Interviews with maritime court judges and their evaluation

On the whole judges' opinions can be regarded as conforming in many cases with opinions of maritime practitioners, both in reference to the equipment of merchant vessels with VDRs and their technical requirements as essential source for the post-accident reconstruction of events and for training purposes and preventive measures.

However, opinions differed in evaluating the importance of VDR recordings and witness statements. It was claimed that one cannot assume in advance that recordings are more important and that a witness does not tell the truth.

On the other hand we may also assume that witness statements may be burdened with unconscious errors as human memory is not faultless and can be unreliable in stress evoking situations, such as marine accidents. The Maritime Court decides which evidence is reliable and justifies it in its reasoning behind the verdict.

Conclusions

To sum up, the results of research into the opinions of Polish maritime experts are convergent with information contained in publications on the role of VDRs in analyses of the course of events and in determining what actually happened. The unquestionable importance of VDRs is confirmed by the British involvement in equipping ships with these devices. The Maritime Accident Investigation Branch (MALB) invested large sums of money to improve the quality of VDR readouts, thus to increase the effectiveness of its investigations [4].

One crucial issue raised in the context of VDR installation on the bridge is that it should not be viewed as a sophisticated method of eavesdropping on crew conversations. There have been cases where evidence from a VDR allowed to identify causes of marine accidents thus relieving ship

captains from charges, or to reveal structural faults of the ships or errors made in the shipowner or port-related training.

It can be therefore stated that VDRs enhance the safety at sea by assisting in the identification of errors and immediately taken preventing measures to avoid identical events in the future.

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